THE Geologic COLUMN OF MISSOURI

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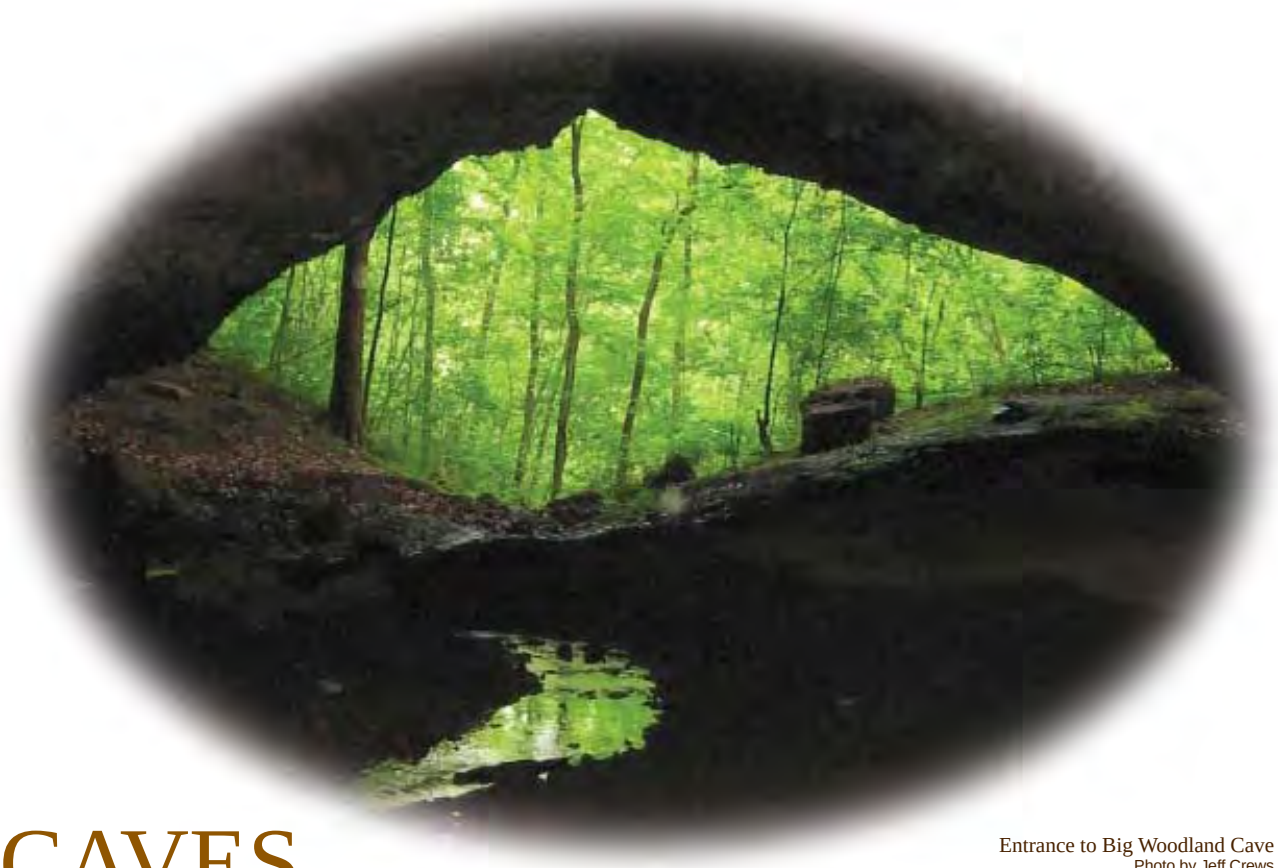


Entrance to Big Woodland Cave
Photo by Jeff Crews

CAVES

MISSOURI, THE CAVE STATE

Missouri is not only known as the SHOW-ME-STATE, but also as the CAVE STATE. This is because we live above and around more than 6,300 recorded caves, a number that continues to grow each year. Caves have been valuable resources for our state's inhabitants. Having been used for shelter, entertainment and storage for the beverage industry, caves also reveal details of past climatic conditions.

Caves are home to many unique forms of life. They are one of the last frontiers of exploration for adventure seekers who enjoy the underground. Caves serve as an integral part of the state's groundwater system. They provide underground conduits that move water to springs that form the headwaters of our state's outstanding rivers and streams.

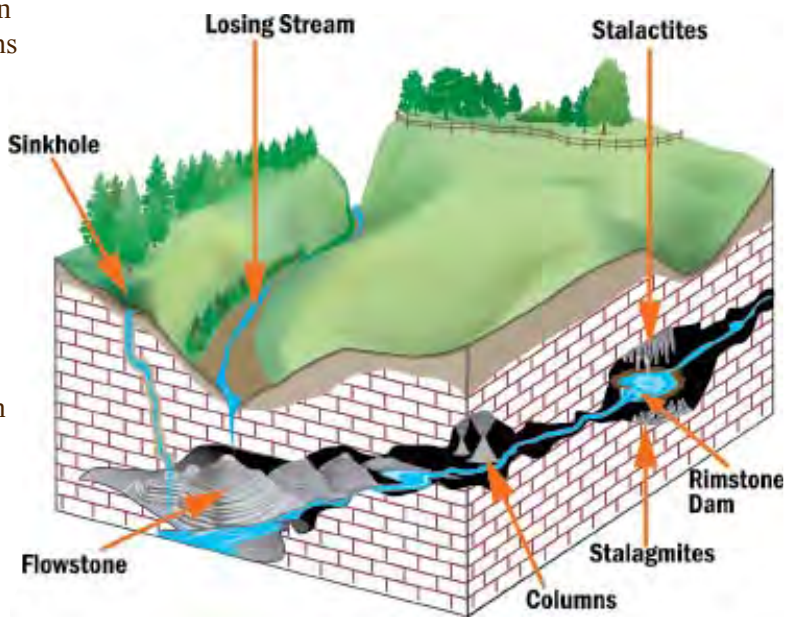
Most of Missouri's caves are found south of the Missouri River in the Ozarks. Bedrock in this region is primarily made up of soluble dolomite and limestone rock formations. Numerous caves are also located between Hannibal and St. Louis, as well as in central Missouri near Columbia.

MISSOURI DEPARTMENT OF NATURAL RESOURCES
Division of Geology and Land Survey

CAVE FORMATION

Near the earth's surface, rainwater combines with carbon dioxide given off by decaying vegetation forming a weak acid called carbonic acid. This acid moves down through joints, bedding planes and other areas of weakness in limestone or dolomite bedrock to create solution-enlarged openings. These openings are the caves and springs that form a part of Missouri's natural beauty. Many people consider caves and springs to be two different features, but springs are just caves that contain water. Welch Spring in Shannon County, the fifth largest spring in Missouri, contains more than one-half mile of cave that one can canoe and walk around in, as well as an underground rise pool where water flows up from a submerged passage. Roubidoux Spring, located in Pulaski County, is a cave that is completely under water and can only be entered by trained cave divers. Divers have mapped more than one mile of underwater passageway, taking them to depths greater than 200 feet below the rise pool. This makes Roubidoux Spring one of the longest and deepest caves in the state.

When springs begin to dry out, beautiful cave deposits known as speleothems begin to form. Water moving down through bedrock enters the cave environment, losing carbon dioxide to the cave's atmosphere. The chemistry of the water changes and the minerals that were once dissolved from the overlying limestone and dolomite begin to grow on the cave's walls, ceilings and floor. Dripstone, in the form of stalagmites and stalactites begin to grow, as do flowstone such as rimstone dams and draperies. Impurities such as iron, manganese and tannic acids often stain the otherwise snowy white minerals into shades of red, orange, brown, gray and black.



CAVE USE

Caves have been used for various purposes since man first set foot in Missouri. Native Americans used caves as shelters, sources of water and as a source for clay and other minerals for roughly 10,000 years. Spanish conquistador and explorer, Hernando De Soto, found saltpeter in caves near Farmington and Branson. Also known as potassium nitrate, saltpeter is an essential ingredient used to make black powder. By the 1720s Phillip Renault was successfully mining saltpeter along the Meramec River in a cave now known as Meramec Caverns. This was the beginning of an industry lasting well into the 1860s. Mushroom growing industries once dotted various parts of the state. A few caves are named after the tasty fungus.

The St. Louis area was once riddled with cave entrances and sinkholes. Urban development has all but eradicated these natural features. However, there was a time in the early 1840s when caves became very important for the beverage industry. The constant temperature of approximately 60 degrees Fahrenheit inside caves provides the ideal refrigeration necessary for the "lagering" of beer. The caves, combined with an influx of German immigrants, gave birth to the brewing industry in Missouri. Breweries and underground entertainment establishments prospered in the city of St. Louis.

Cave tours have been given in Missouri for more than 100 years. The early tours consisted of what we would today consider ecotours. Cave visitors often scrambled over muddy banks and slogged through cave streams as they explored the caves with their guides. As tourism grew so did tourist trails in Missouri's commercial caves. Now, for the comfort of visitors, most commercial caves have concrete walkways and electric lighting along the tour route.

DNR photo

Cave Tour Group at Onondaga Cave in the early 1900s

A MOMENT IN TIME

Onondaga Cave has been a tourist attraction since 1897. Charles Christopher was the cave's discoverer and leader of this early tour (pictured on the far right holding a lantern). In 1930, Dr. William Mook learned that Onondaga Cave was under the property that he leased for use as a resort for doctors. Dr. Mook and his brother, Robert Lee Mook, dug a tunnel into the cave and erected a barbed wire fence across "The Big Room," at the supposed property line. Bob Bradford, the owner and tour operator of Onondaga Cave at the time, was told to stop trespassing. This was the beginning of a property dispute that was to last until May of 1935 when the Missouri Supreme Court ruled in favor of the Mook brothers. This ruling set a precedent for the establishment of underground property rights. The ruling reached beyond caves and impacted the quarrying, mining, oil and gas industries in Missouri.

DNR photo

Charles Christopher leads a cave tour at Onondaga Cave

CAVES IN MISSOURI

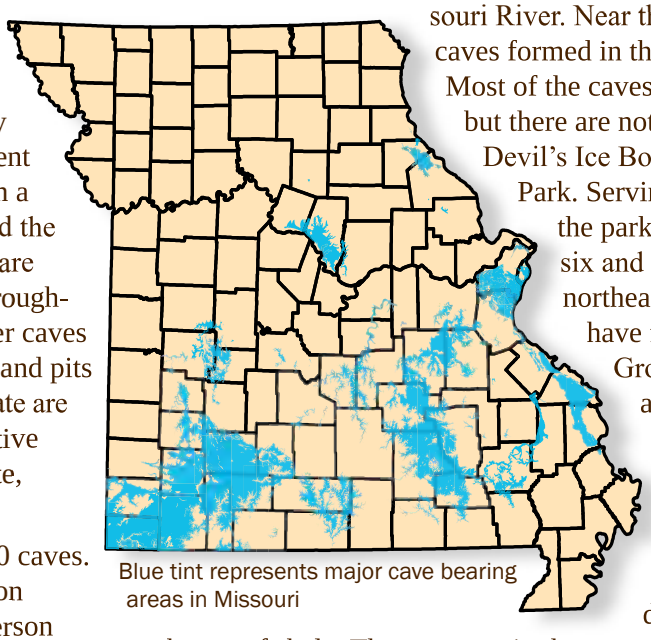
Caves found in the central Ozarks are typically formed in the Eminence Dolomite, the Gasconade Dolomite or the Roubidoux Formation. The majority of water wells in the state are open to these same rock formations. Protecting the water quality in caves is closely tied to protecting our own source of clean drinking water. These caves are often heavily decorated with cave deposits, have small flowing streams, and have accumulated thick clay, making exploration challenging yet rewarding.

Surrounding the central Ozarks are other areas of cave development. In southeast Missouri near the town of Perryville, in Perry County, lies the most intense cave development in the state. More than 600 caves are found in a narrow strip of land between Interstate 55 and the Mississippi River. The majority of the caves are small pits found in the bottom of sinkholes throughout the county. However, several large, deeper caves collect water funneled through the sinkholes and pits above. Four of the five longest caves in the state are comprised of these deeper, hydrologically active cave systems formed in the Joachim Dolomite, Plattin Limestone and Decorah Group.

Southwest Missouri contains more than 1,000 caves. They are found in rocks such as the Burlington Limestone and at the contact between the Pierson Limestone and the Reeds Spring Formation. A few caves in the region are also found in the Cotter Dolomite. Marvel Cave at Silver Dollar City is the deepest cave in the state. It crosses portions of three of these geologic formations.

In and around the greater St. Louis area several cave systems have been developed for uses such as transportation tunnels, cold storage, and for entertainment purposes. However, urban development can also be attributed to the loss of many of these natural treasures. Several caves are protected in parks throughout the greater St. Louis area. These caves are found in rock units such as the St. Genevieve and St. Louis Limestone, the Decorah Group and the Plattin Limestone.

Caves are found in abundance at two locations north of the Missouri River. Near the city of Columbia, caves formed in the Burlington Limestone. Most of the caves in this area are small but there are notable exceptions such as Devil's Ice Box in Rock Bridge State Park. Serving as a centerpiece in the park, the cave is more than six and one-half miles long. In northeast Missouri, many caves have formed in the Decorah Group, Plattin Limestone, and the Burlington Limestone. Near Hannibal are maze caves unlike any others in the state. They are found in the Louisiana Limestone and are developed between two layers of shale. The passages in these caves have formed along regularly-spaced joints, creating a high density of confusing passageways. Exploring these caves would have provided legendary writer Mark Twain plenty of inspiration for writing about hiding in and exploring caves.

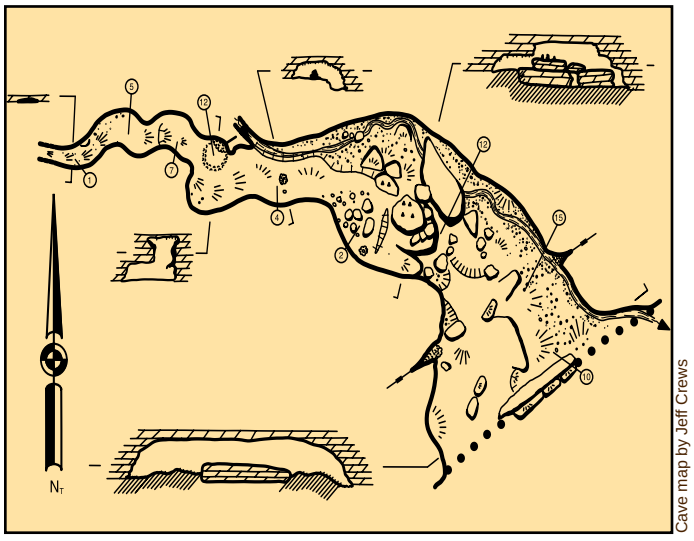


Blue tint represents major cave bearing areas in Missouri

EXPLORATION

Native Americans were the first people to explore Missouri's underground. Aside from using caves for utilitarian purposes, it is reasonable to believe that they were drawn to the natural beauty of caves and explored them simply out of curiosity. A few European settlers entered caves as the region was settled, but serious exploration did not start until around 1906. Small caving clubs formed around cities and universities. These early grottos were a loose collection of people interested in caves and the thrill associated with exploring them.

After World War II ended, cave exploration blossomed. Caves were one of the few places where one could be the first to see a pristine underground chamber or leave the first man-made footprints. There are still many caves in the state waiting for their first visitor. The far reaches of extensive caves remain the last frontier in Missouri. In 1956, a small group of cave explorers from central Missouri, with an interest in the scientific investigation of caves, formed the Missouri Speleological Survey (MSS). The organization was founded as a non-profit consortium with the mission to collect information and provide a knowledge base for researchers interested in caves. In order to meet its goals, the MSS entered into a cooperative agreement with the Missouri Geological Survey and Water Resources (now the Division of Geology and Land Survey) to provide a permanent repository of material gathered by the MSS and its affiliate groups. Today, the MSS maintains a digital database of cave information, such as the number of caves in the state. Cave maps continue to be submitted to the Division of Geology and Land Survey where they are archived, placed in digital format, and made available to the public. In 2006, 17 authors submitted 113 different cave maps.



Cave map by Jeff Crews

Map of Decker Cave in Pulaski County

CAVE LIFE

Unique aquatic species including blind cavefish, freshwater shrimp, isopods and crayfish make caves their home. These organisms have no pigment and extremely small eyes, if any eyes whatsoever. This is due to the dark, underground living conditions. Of the numerous underground inhabitants, bats tend to get the most attention. Large colonies of gray bats exiting a cave on a summer evening can be a very impressive experience. Several cave-dwelling bats are on the endangered species list. Caves are also home to salamanders, millipedes, centipedes, snails, spiders and other species that have adapted to life exclusively underground.

Many of these creatures depend on water moving through the cave for food, oxygen and other basic requirements to sustain life. Since the water moving through caves originates as rainfall traveling through the rock and soil above, the water may contain pollution from the ground surface. These underground creatures are very sensitive to changes in water quality. A sharp decrease in cavefish numbers can often be linked to surface pollution that has reached the cave. This makes the cavefish a good indicator species for water quality.

CAVE PROTECTION LEGISLATION

There are two pieces of legislation that are designed to protect Missouri caves. The Federal Cave Resources Protection Act of 1988 is intended to secure, protect and preserve significant caves on federal land. The act requires federal land managers to treat caves responsibly. It also prohibits certain activities within caves without proper permits.

In 1980, the Missouri Legislature enacted the Missouri Cave Resources Act. This legislation recognizes the value of caves by establishing specific penalties for vandalism; but at the same time, it maintains the right of private cave owners to manage or use their caves as they see fit. It also provides cave owners with legal authority to protect their caves from trespassers. The Act offers protection for the surface of a cave as well as the natural materials it contains, such as stalactites, stalagmites, cave life and paleontological (fossil) remains. The law helps to protect the quality of Missouri's groundwater supplies. It establishes specific legal protection for anyone whose well supply or spring has been polluted by someone using a cave for sewage disposal or other pollution-causing purposes. The Cave Resources Act has been used successfully to prosecute violators who have committed acts of vandalism and trespass.

CAVES IN OUR STATE PARKS

"This morning...I discover'd a Cave...I think it one of the most remarkable Caves I ever saw in my travels."
Journal: Joseph Whitehouse, Lewis and Clark Expedition, May 28, 1804

There are three outstanding show caves open for public tours in the state park system. One of these, Fisher Cave, is located in Meramec State Park, while Ozark Caverns, with its unique and breathtaking "Angel Showers," is at Lake of the Ozarks State Park. Onondaga Cave, located in Onondaga Cave State Park, is justly celebrated for its beautiful deposits including colorful dripstones and flowstones, and the spectacular "lily pad" room. A cave with a wild flavor is the Devil's Icebox Cave in Rock Bridge Memorial State Park. With more than seven miles of passageways, this cave is Missouri's sixth longest, and can be toured by special arrangement. Additionally, the naturalist at Ha Ha Tonka State Park often leads programs that take people into River Cave.

A trip to one of these parks offers visitors the opportunity to see natural geologic wonders that are unique to the cave environment. Park visitors can traverse narrow passageways and behold cavernous rooms filled with spectacular geologic wonders such as stalactites, draperies and soda straws.

DNR photo by Nick Decker

Angel Showers in Ozark Caverns,
Lake of the Ozarks State Park

THE DIVISION'S ROLE IN PROTECTING CAVES AND GROUNDWATER

In addition to its agreement with the Missouri Speleological Survey to archive and maintain the database of cave information, staff geologists also use the cave information on a daily basis. Information from the database provides insight into the geologic framework of karst features and groundwater movement. Geologists take into account the presence of caves when evaluating the suitability of sites for various wastewater treatment systems, landfill facilities and when assisting with the clean up of hazardous waste sites. The proximity of caves, sinkholes and other solution features are considered in determining the likelihood of sinkhole collapses forming under wastewater impoundments or landfills.

2007 NATIONAL CAVE AND KARST MANAGEMENT SYMPOSIUM

Four staff geologists who work daily with environmental challenges associated with the karst landscape in Missouri, presented information at the 2007 National Cave and Karst Management Symposium. At the symposium, (held in St. Louis, October 8-12), Jerry Prewett presented a paper about the formation of soil cover collapse sinkholes. Neil Elfrink talked about the formation of springs and their influence on river meanders. Jeffrey Crews presented research completed as part of a master's thesis about carbon isotopes in cave water. Larry Pierce participated in a poster session offering information about groundwater tracing and the role geologists play in enforcement of Missouri's environmental regulations. Division of Geology and Land Survey staff members are considered technical experts regarding Missouri karst issues. Participants at the conference came from as far away as the Virginias, Kentucky, New Mexico, Oregon, Tennessee, Texas and the Yucatan Peninsula.

DNR photo by Mark Gordon

Entrance to Fisher Cave at Meramec State Park

WEB SITES

More information about caves is available at these Web sites:

Caves in Missouri's State Parks
www.mostateparks.com/karst.htm

Exploration of Missouri's Caves
www.mospeleo.org

Missouri Caves Association
www.missouricaves.com

Cave Conservation
www.mocavesandkarst.org

Cave Research
www.cave-research.org

Caves in General:
www.caves.org

PUBLICATIONS

ED-4. **Geologic Wonders and Curiosities of Missouri,** by Thomas Beveridge, second edition, revised by Jerry Vineyard, 1991.

POA-14. **The Wilderness Underground – Caves of the Ozark Plateau,** by Dwight Weaver, 1992. Photos editors – James N. Huckins and Rickard L. Walk.

WR-40. **Movement of Shallow Groundwater in the Perryville Karst Area, Southeastern Missouri,** by James E. Vandike, 1985.

Cave Maps – 18x24 paper copies of individual cave maps or entire collection on CD.

DGLS Trading Cards – Four sets of trading cards available with pictures of caves and springs with facts about both. Sets also have many other geology and land surveying facts and photos.

These and other publications may be purchased through the Missouri Department of Natural Resources, Division of Geology and Land Survey. To order, contact the publications desk at: (573) 368-2125 or 1-800-361-4827, or use our online form at: www.dnr.mo.gov/geology/adm/publications/MapsOrder.htm.
For additional information visit our Web site: www.dnr.mo.gov/geology, or call: (573) 368-2100.

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